2016

Changes in parent and child pain sensitivity over the course of pediatric pain rehabilitation treatment

BOSTON UNIVERSITY

SCHOOL OF MEDICINE

Thesis

CHANGES IN PARENT AND CHILD PAIN SENSITIVITY OVER THE COURSE OF PEDIATRIC PAIN REHABILITATION TREATMENT

by

ALINA AGAMOV

B.A., Boston University, 2014

Submitted in partial fulfillment of the

requirements for the degree of

Master of Science

2016

Approved by

First Reader _____

Matthew D. Layne, Ph.D.
Associate Professor of Biochemistry

Second Reader _____

Christine Sieberg, Ph.D.
Attending Psychologist
Pain Treatment Service
Department of Anesthesia – Boston Children's Hospital

CHANGES IN PARENT AND CHILD PAIN SENSITIVITY OVER THE COURSE OF PEDIATRIC PAIN REHABILITATION TREATMENT

ALINA AGAMOV

ABSTRACT

Objectives: This study compared mother, father, and child self-reported pain sensitivity and psychosocial functioning during an intensive pediatric pain rehabilitation treatment.

Methods: Twenty children with chronic pain and their parents were enrolled in an intensive pediatric pain rehabilitation center and completed measures of pain sensitivity, fear of pain, pain catastrophizing, functional disability, and current and usual pain ratings at admission and discharge.

Results: Bivariate correlations and one-way ANOVAs were used. Pain sensitivity and psychosocial variables for mother, father, and child decreased from admission to discharge. There was no correlation between pain sensitivity and psychosocial variables and no significant main effect for time.

Conclusions: Results indicate a need for a larger sample to further explore the relationship between these variables.

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

FDI……..…..Functional Disability Inventory

FOPQ……..……Fear of Pain Questionnaire

IRB……..Institutional Review Board

MRI……....Magnetic Resonance Imaging

PCS……...Pain Catastrophizing Survey

PPRC.....Pediatric Pain Rehabilitation Center

PSQ .....Pain Sensitivity Questionnaire

QST…….....…….Quantitative Sensory Testing

(

INTRODUCTION

Chronic pain has been defined by the American Pain Society as pain that has been constant, ensuing for at least three months, and reoccurring at least three times weekly (American Pain Society, 2012). Approximately 100 million Americans are living with chronic pain, which costs the United States approximately $635 billion annually in pain-related disability (Gaskin and Richard, 2011). Chronic pain also impacts children with up to a quarter of children suffering from chronic pain (Simons, Sieberg, Pielech, Conroy, & Logan, 2013; American Pain Society, 2012; Goodman & McGrath, 1991; Roth-Isigkeit, Thyen, Stoven, Schwarzenberger, & Schmucker, 2005; Carter and Threlkeld, 2012).

Many studies have found that chronic pain is more prevalent in females and increases with age (Perquin et al., 2000; Arnold et al., 2004; Zernikow et al., 2012; Lynch, Kashikar-Zuck, Goldschneider, & Jones, 2006; Stanford, Chambers, Biesanz, & Chen, 2008; Geraghty & Busem, 2015). Psychosocial variables, such as pain catastrophizing, (i.e., viewing or talking about a situation as worse than it actually is), and fear of pain play an integral role in those living with chronic pain. Anxiety, coping mechanisms, and activity level are also related to increased pain intensity (Sieberg, Williams, & Simons, 2011; Celedon, Amari, Ward, Prestwich, & Slifer, 2014.) and associated disability. Logan, Simons, & Carpino (2012) found a relationship between pain catastrophizing and functional disability. A lower quality of life is found in chronic

pain patients, as many are constantly worried about, fearful of, and trying to avoid their pain (Eccleston & Crombez, 2007; Simons, et al., 2014).

Zernikow et al., (2012) performed a retrospective study to determine whether there were underlying characteristics in children who had chronic pain. They asked the children and parents to complete questionnaires followed by an evaluation visit with the children. They found that almost 50% of the children rated their pain as a six out of ten. The most critical underlying characteristics found were the correlation between age and pain intensity, with girls being the most susceptible. It has also been found that children from a low socioeconomic status families are more prone to experience functional disability, whereas children from a higher socioeconomic status family are more likely to have a higher self-worth in regards to their athletic ability and personality (Guite, Logan, Sherry, & Rose, 2007). Perquin et al., (2000) examined the "frequency, duration, and intensity" of pediatric chronic pain among a sample of healthy children from birth to eighteen in the Netherlands. For children, between the ages of zero and three, the questionnaire was sent to the parents and those between ages four and eighteen, completed questionnaires at school with the school nurse. Table 1 indicates that pain intensity is greater in children with a history of chronic pain than for those without a history. Results also indicate that the mean pain intensity is greater overall for girls compared to boys with the greatest mean pain intensity between the ages of eight and eleven (Table 1).

Table 1. Comparing children with chronic pain to those without chronic pain. Mean pain intensity distinguished by gender and age. Adapted from Perquin et al., (2000).

	Chronic pain			Non-chronic pain		
	Mean intensity	SD	*P* value	Mean intensity	SD	*P* value
Total	54.4	24.2		41.2	24.4	
Gender			<0.001			NS
Boys	50.7	25.0		40.2	24.5	
Girls	56.6	23.5		42.1	24.4	
Age (years)			<0.001			<0.001
0–3	54.7	27.7		36.6	27.7	
4–7	45.9	23.5		32.7	24.1	
8–11	58.3	24.7		43.7	25.6	
12–15	54.9	23.5		42.1	22.4	
16–18	54.4	21.8		37.5	20.8	

Stanford, Chambers, Biesanz, and Chen (2008) examined longitudinal pain trajectories in pediatric pain patients. By administering questionnaires and surveys over an eight-year period to children, parents, schools, and teachers, they wanted to determine whether psychosocial factors were able to predict chronic pain. They found differences in pain intensity between the biological sex when performing chi-square tests, with girls having a greater prevalence to pain. Among 10-11 year old girls, whose teachers rated them on a higher scale of anxiety and depression, an increase in stomachaches were found as the study continued. Whereas participants, who described themselves to be less anxious and depressed, had an increase in stomachaches as the study continued.

Public Health Impact

Global health has lacked in research on the health of adolescents (Swain et al., 2014; Lynch et al., 2006). This has made it difficult to determine the breadth of the issue of pediatric chronic pain. According to the National Pain Foundation, two in five children

experience perpetual and ongoing pain every week (Young & Kemper, 2013). Children with chronic pain tend to abstain from activities with their peers leading to escalation of their disability, which continues to contribute to the issue of pain (Caes, Vervoort, Eccleston, Vandenhende, & Goubert, 2011). Chronic pain results in an interference of daily life activities such as school attendance, familial and social relationships, self-esteem, and emotional development, which often lead to problems once in adulthood (Celedon, et al., 2014; Gaughan, Logan, Sethna, & Mott, 2014; Geraghty & Busem, 2015).

Chronic pain infiltrates all portions of ones life; not only by what is occurring physically, but is what is happening internally and how it is affecting the lives of the people around them (Figure 1). These children have been found to be more likely to experience feelings of depression, anxiety, and low self-esteem (Eccleston, Crombez, Scotford, Clinch, & Connell, 2016; Stanford et al., 2008; Gauntlett-Gilbert & Eccleston, 2007; Guite, et al., 2007). The pain that is experienced in childhood is an indication of pain that may be anticipated in adulthood (Swain et al., 2014).

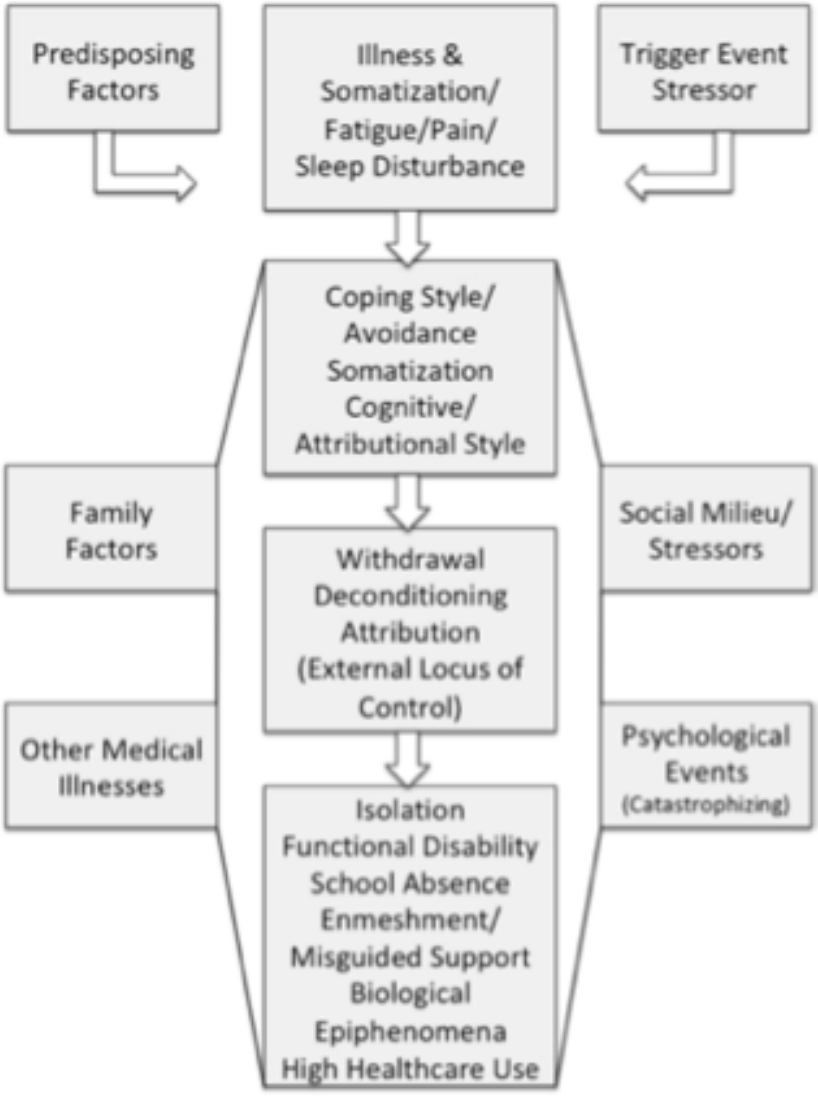

Figure 1. Chronic Pain Model. Describing contributing factors to the model of chronic pain. Adapted from Carter & Threlkeld, 2012.

Biopsychosocial Model

The biopyschosocial model has been a focus in pain research, with many tertiary pain rehabilitation facilities basing their treatment methods from its emphasis on the integration of the physical, psychological, and social aspects of one's life (Celedon et al., 2014) and help to elucidate the pain complex interaction and connection between parents

and children (Figure 2) that may maintain and exacerbate pediatric chronic pain (Goodman & McGrath, 1991). Palermo and Chambers (2005) emphasize the importance of studying the familial environment, as it does not only focus on the parenting behavior, but also on the relationship between parent and child. Family dynamics are critical to look into when it comes to children with chronic pain, especially due to its lack in literature (Palermo & Chambers, 2005; Gaughan et al., 2014).

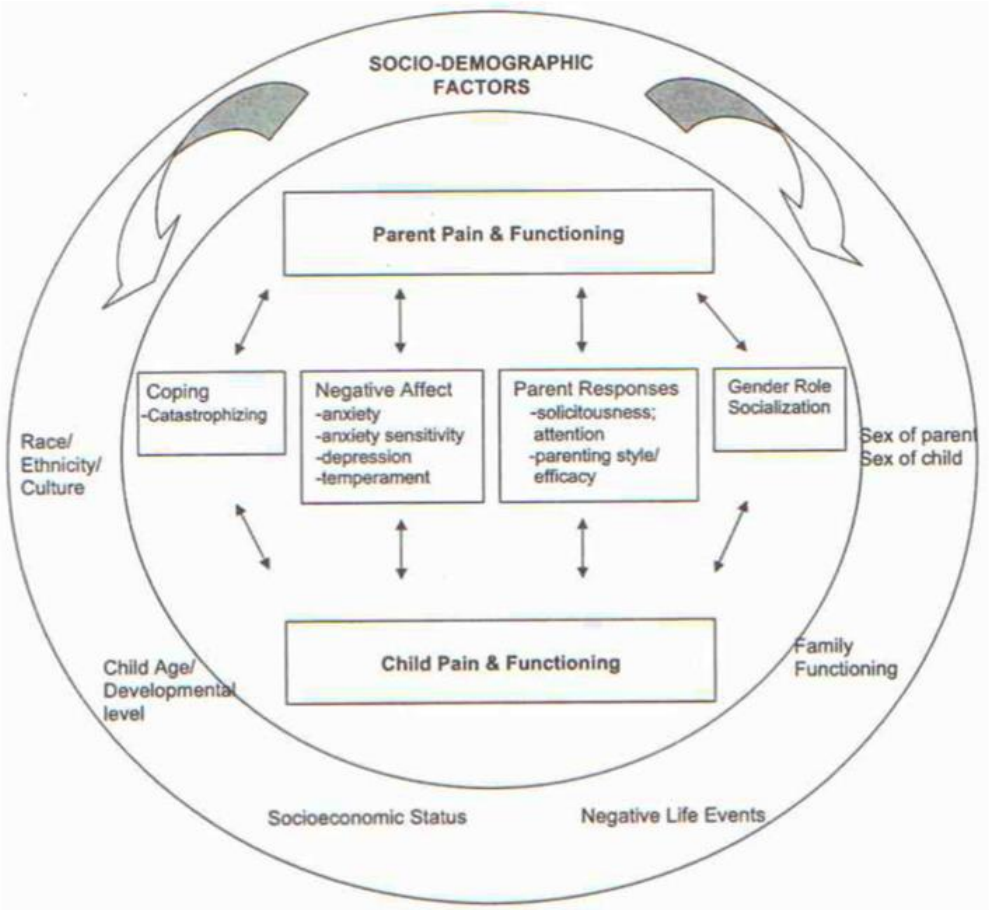

Figure 2. Psychosocial Model. Model explaining the connection between parent and child experiencing pain. Adapted from Evans et al., 2008.

Evans et al., (2008) performed an extensive literature review that focused on a link between parent and child pain, as well as the mechanism driving the relationship. While biosychosocial factors were all found to be salient determinants of pediatric chronic pain, they highlight the importance of the parent-child pain relationship. One such finding was how social modeling influences a child in regards to their response to pain. Another finding from the literature was that many studies found children to be more likely to experience pain if their parents have multiple locations of pains and multiple pain conditions (Saundm, Korff, Leresche, & Manci, 2007; Laurell, Larsson, & Eeg-Olofsson, 2005; Evans, Keenan, & Shipton, 2007). Many studies have examined this, finding that children, who are exposed to parents with pain and concentrate on that pain, are more likely to experience pain themselves (Bruehl, France, France, Harju, & al'Absi, 2005; Osbome, Hatcher, & Richtsmeier, 1989). This highlights a main conclusion as to the importance of parents influencing their child through observation.

From the moment a child is born, he or she is constantly learning from its surroundings with their parents as their guide. The way a parent responds to their own child experiencing chronic pain, impacts that child (Geraghty & Busem, 2015). Parents who catastrophize about their child's pain can perpetuate pain-related disability (Geraghty & Busem, 2015). Catastrophizing influences both parent and child pain and functioning (Figure 2). Caes et al., (2011) found that parents, who showed catastrophizing behavior while watching their child perform painful activities (i.e., cold-pressor task, heat-pressor task, walking task to induce pain) were more likely to experience feelings of distress and prevent their child from participating. Additionally,

Hechler et al., (2011) found a correlation between parental catastrophizing and child's pain intensity, particularly in mothers. As mothers are usually the ones to spend more time with their children, their reaction is the one a child is viewing and interpreting. Parents influence the way a child responds to their own pain (Logan, Simons, & Carpino, 2012).

Gaughan et al., (2014) wanted to determine how parental behavior and attitude influenced their child's response to treatment for their chronic pain. All of the participants were enrolled in an intensive rehabilitation setting. The researchers collected data through interviews with parents, focusing more on the parents' own interpretation of their child's pain. They found these parents to be experiencing distress and pessimistic thinking towards their parenting capabilities. With the parents feeling this way, it made it difficult for them to help their children. Only once they stopped feeling as though they were failing, were they able to help support and help their children. These researchers found family functioning to be a crucial element in dealing with pediatric chronic pain, which has also been found in other studies (Caes et al., 2011; Logan & Schraff, 2005; Sieberg, Williams, & Simons, 2011; Lewandowski, Palermo, Stinson, Handley, & Chambers, 2010).

Simons, Claar, and Logan (2008) studied the relationship between adolescents coping with their pain, parental responses, and adolescents' pain behavior. Participants aged twelve to seventeen completed questionnaires of coping, pain intensity, and children's ability to perform physical and psychosocial activities. They were also asked to rate their present pain. They found an inverse relationship between coping and parental

responses - that the less an adolescent coped with their pain, the more likely there would be a maladaptive parental response. The greater the parental response was, the more likely the adolescent experienced disability and physical symptoms.

Higgens et al., (2015) performed a meta-analysis to better understand how parental chronic pain impacts their children. Studies were divided into clinical and population-based and then analyzed based on different outcomes such as "pain, health, family, and psychological outcomes." They found that children of parents with chronic pain had worse outcomes in these categories than children of controls.

Evans, Keenan, and Shipton (2007) were interested in how parental variables impacted their child's health outcome. Families in which mothers had chronic pain were recruited to test their hypotheses. Mothers, fathers, and teachers were asked to fill out questionnaires regarding their perception of the child's behavior, social skills, and illness behavior. Children filled out similar questionnaires, but were also asked to partake in a separation anxiety test to look at attachment security. Children of chronic pain parents were more likely to experience insecure attachment than those of healthy controls. It was found that children of parents with chronic pain were more at risk than children of controls, determining that those children had ascribed pain and difficulty in social settings.

Lewandowski, Palermo, Stinson, Handley, and Chambers (2010) performed a meta-analysis that compared families with children with chronic pain to those without in order to determine how family functioning (i.e., conflict, cohesion, communication, and enmeshment) was affected if it had a child with chronic pain. Two-thirds of the studies

that were analyzed found a correlation between positive family functioning and decreased pain disability.

Logan and Schraff (2005) performed a cross-sectional study that focused on how family functioning could impact the relationship between intensity of and impairment due to the pain. Children recruited for this study had pain for an average of over two years. Both parents and children completed questionnaires. Additionally, children recorded entries in a pain diary and parents noted on the family environment. Family characteristics, such as enmeshment and conflict within the family, depict a relation with pain disability in children. Through these findings, the researchers found that child is more likely to experience chronic pain if raised in a family with these characteristics.

Family Social and Genetic Influence

It has been widely demonstrated that children who have a family member with chronic pain are at risk for the development of chronic pain and negative outcomes. Having a parent who experiences headaches and migraines increases the likelihood that their child will experience them as well (Aromaa, Rautava, Helenius, & Sillanpaa, 1998; Stanford et al., 2008; Laurell et al., 2005; Anttila, Metsahonkala, Helenius, & Sillanpaa, 2000; Palermo, Valrie, Karlson, & Anderson, 2014; Schanberg et al., 2001). Children of parents and siblings who experience recurrent abdominal pain were more likely to experience it as well (Boey & Goh, 2001). Nielsen et al., (2008) compared pain sensitivity in identical and fraternal twins by performing tests that studied cold and heat pain differences and found a correlation with pain sensitivity. Parents, whose children experience headaches, tend to have increased pain sensitivity (Aromaa et al., 2000).

Children who experience chronic pain often come from families with a history of pain (Evans et al., 2008).

Family factors also assume a critical role in children with chronic pain. It has been demonstrated that children with a family member, who is living with chronic pain, have negative outcomes (Young & Kemper, 2013; Arnold et al., 2004; Higgens et al., 2015). Evans, Keenan, and Shipton (2007) found social difficulty and heightened pain grievances among children who had a mother with chronic pain. Young and Kemper (2013) found histories of mental illness and substance abuse in their pediatric chronic pain participants. Kashikar-zuck et al., (2008) found depression to be a common factor in the mothers of children with juvenile primary fibromyalgia syndrome compared to healthy controls. Higgens et al., (2015) found children born to mothers, who have chronic pain, to be more likely to have pain grievances.

Laurell, Larsson, and Eeg-olofsson (2005) tested whether children who experienced migraines were more likely to experience pain, and difficulty, both psychologically and socially, compared to healthy controls. The researchers interviewed children regarding family history, pain ratings, and psychological and social factors. They found that children who experienced migraines were more likely to have social, but not psychological (i.e. anxiety and depression) deficits. They believed that these social deficits could have occurred due to constant absences from school or frequent visits to the nurse, which led to exclusion from school activities. Of the children who experienced migraines, 66% of them had a first-degree relative who reported experiencing migraines as well.

Lynch et al., (2006) studied how family history impacted pediatric pain patients. They asked children to complete multiple pain measures such as pain intensity, coping, and disability, and parents provided information regarding family history and demographics. It was found that almost half of the participants had a family history of pain. Of these children, they were found to have greater impairment compared to children without a family history.

Schanberg et al., (2001) wanted to determine whether a relationship existed between parents and children with chronic pain. Parents were asked to complete questionnaires regarding demographics and family history, while children completed questionnaires regarding coping, intensity, and pain ratings. Of all the parents, 93% had at least once family member who dealt with chronic pain. They found child pain ratings to correspond with those of their parents. They also found family pain history to be a predictive measure of chronic pain in children.

This research highlights the importance of trying to determine which children are predisposed to chronic pain and thus they will be able to be treated sooner.

Pain Sensitivity

Differences in pain sensitivity are correlated with differences in pain ratings. Someone with low pain sensitivity will take longer to seek help than someone with high pain sensitivity (Nielsen, Staud, & Price, 2009; Granot, Khoury, Berger, Krivoy, Braun, Aronson et al., 2007). Rolke and colleagues (2006) developed the Quantitative Sensory Testing (QST) in order to evaluate sensation in patients with neuropathic pain with the

goal to determine its mechanism. The protocol consisted of seven tests measuring thirteen variables and took up to an hour to complete for two parts of the body. Pinprick pain threshold and pinprick stimulus threshold are measured with von Frey filaments. The former is to determine at which point the participant first feels sharpness, while the latter asks the participant to state at which point they feel anything in general. Pressure pain threshold is deterred using a pressure gauge device, with participants giving notice when they can no longer bear the pressure. Vibration detection threshold is determined using a tuning fork and asking the participant when they can no longer feel the vibration. Heat and cold pain threshold is measured using a thermode system, which consists of two portions. In the first portion the participants is asked to inform the researcher when they feel a temperature change. In the second portion the participant is asked to inform the researcher when they can no longer stand the temperature. This was found to be a novel form of testing somatosensory functions across multiple parts of the body in one sitting.

The QST has been most commonly used to determine pain sensitivity in neuropathic pain patients (Starweather et al., 2016; O'Neill & O'Neill, 2015). Knutti, Suter, and Opsommer (2014) performed a test-retest experiment on the QST and found validity when it was performed on the lumbar spine, as Rolke et al. (2006) only measured this somatosensory test on the face, hands, and feet of their participants. Granot et al., (2007) compared patients with a painful heart attack with those who experienced a silent heart attack. Using a QST, they found that those in the latter group had lower pain sensitivity and were thus at an increased risk (Granot et al., 2007). Increased pain

sensitivity corresponds with increased risk to chronic pain (Nielsen, Staud, & Price, 2009; Granot et al., 2007)

More recent studies have questioned the reliability of the QST (Moloney, Hall, & Doody, 2012; Starweather et al., 2016, O'Neill & O'Neill, 2015). Two of the concerns with the QST regarding validity are bias from the rater and error during the testing (Moloney, Hall, & Doody, 2012; O'Neill & O'Neill, 2015). Moloney, Hall, & Doody (2012) performed a systemic review of studies using the QST and found that only fourteen percent provided information regarding the rater. The rater must be someone who has been trained to administer the QST. There is concern regarding inconsistency between raters due to them coming from multiple training vicinities to perform the same study (Moloney, Hall, & Doody, 2012; O'Neill & O'Neill, 2015). O'Neill & O'Neill (2015) found the best way to have accurate results would be to have fewer raters testing on multiple occasions to get the best reliability.

Ruscheweyh et al., (2012) tested pain sensitivity through administration of both the Pain Sensitivity Questionnaire (PSQ), a self-report assessment of pain sensitivity, and the QST on chronic pain patients and healthy controls. The QST consisted of multiple portions: pinprick pain threshold, pinprick stimulus threshold, pain intensity ratings, pressure pain threshold, heat and cold pain thresholds, and a cold pressor test. Throughout this procedure participants were asked to rate their pain on an eleven-point scale of zero, no pain, to ten, worst pain imaginable. There was a positive correlation between PSQ scores and experimental threshold pain scores from the QST. There was also a positive correlation between PSQ scores and those of the pain intensity rating

score. The researchers found that the PSQ scores were higher in those with chronic pain and lower in the healthy controls. With the PSQ taking only five to ten minutes to complete without the need of a trained individual, it is a straightforward way to measure experimental pain (Ruscheweyh, Marziniak, Stumpenhorst, Reinholz, & Knecht, 2009) and can offer insight into the role of underlying biological mechanisms and how they may impact pain expression.

Kim et al., (2013) examined whether pain sensitivity measured using the PSQ would be able to predict recovery of adults with degenerative spinal disease post-surgery. They collected medical history, physical exams, questionnaires, PSQ, and MRI results for each participant. They determined that three of the seventeen questions are not considered to be painful in healthy controls. The remaining fourteen were separated into two categories, minor and moderate (Table 2). PSQ-minor was considered to cause minimal pain, rating below four, and PSQ-moderate was considered to cause more pain, rating above four in healthy controls (Ruscheweyh et al., 2009). The researchers found a direct correlation between pain sensitivity and the time it would take to recover.

Researchers studying pain sensitivity within a pediatric chronic pain cohort have conducted them at an interdisciplinary pain rehabilitation center. The studies conducted on these types of programs suggest their efficacy. Maynard, Amari, Wieczorek, Christensen, and Slifer (2010) performed a study comparing chronic pain patients at admission, discharge, and three-month follow-up after spending time at an interdisciplinary rehabilitation program. Their findings showed that at discharge and

Table 2. Subscores of the PSQ. Adapted from Kim et al., (2015).

Pain sensitivity-minor	
3.	Imagine your muscles are slightly sore as the result of physical activity.
6.	Imagine you have mild sunburn on your shoulders.
7.	Imagine you grazed your knee falling off your bicycle.
10.	Imagine you have a minor cut on your finger and inadvertently get lemon juice in the wound.
11.	Imagine you price your fingertip on the thorn of a rose.
12.	Imagine you stick your bare hands in the snow for a couple of minutes or bring your hands in contact with snow for some time, for example, while making snowballs.
14.	Imagine you shake hands with someone who has a very strong grip.
Pain sensitivity-moderate	
1.	Imagine you bump your shin badly on a hard edge, for example, on the edge of a glass coffee table.
2.	Imagine you burn your tongue on a very hot drink.
4.	Imagine you trap your finger in a drawer.
8.	Imagine you accidentally bite your tongue or cheek badly while eating.
15.	Imagine you pick up a hot pot by inadvertently grabbing its equally hot handles.
16.	Imagine you are wearing sandals and someone with heavy boots steps on your foot.
17.	Imagine you bump your elbow on the edge of a table ("funny bone").

follow-up participants had improved physical and psychological functioning, sleep, school attendance, and had decreased medication use (Maynard et al., 2010).

Not only are these interdisciplinary rehabilitation programs less expensive than inpatient rehabilitation programs, they have been proven to decrease pain and functional disability, while increasing limb functioning (Logan et al., 2012; Simons et al., 2013). Simons et al., 2013 compared patients at the Pediatric Pain Rehabilitation Center (PPRC) with those in an outpatient treatment facility and found that those participating at the

PPRC showed greater progress and improvement in functional disability than those participating in an outpatient treatment facility. All of the participants from the PPRC who returned for follow-up continued with the strategies they learned, thus showing their initiative to control their pain (Simons et al., 2013). Logan et al. (2012) studied participants from the first year that the PPRC are open. Not only was there significant improvement from admission to discharge, but also at an average of 10-month follow-up 90% of participants reported improvement in functional status, and self-perception and satisfaction with performance (Logan et al., 2012).

Specific Aims and Objectives

This study aims to address the biopsychosocial model for families coping with a child, who has complex, treatment refractory chronic pain. There is a need for this as a dearth of research has been done trying to determine genetic and social components of pain sensitivity in regards to chronic pain.

The specific aims of this study are:

1. To explore the underlying sensitivity profile for children and their parents who are enrolled in an interdisciplinary intensive pediatric pain rehabilitation program.
2. To assess whether a parents' underlying sensitivity relates to child pain, sensitivity, or psychosocial functioning.
3. a.) To determine whether child-reported pain sensitivity improves from admission to discharge in an intensive pain rehabilitation program.
   b.) To determine whether parents' own pain sensitivity can improve over the course of treatment for their child's chronic pain.

Methods

Participants

The Institutional Review Board (IRB) approved this study to administer and use data for clinical purposes within the program. Participants who completed written consent forms had their data used for the research purposes of this study. Patients and parents enrolled in an interdisciplinary pediatric pain rehabilitation program were recruited to participate in the study. Overall, there were twenty child participants (mean age = 14.05 years, SD = 2.89 years), with one missing PSQ data due to unknown reasons, eighteen mothers, and nine fathers. The sample was mostly female (75%) and caucasian (95%). Participants had an array of diagnoses, with a majority experiencing headache (30%), musculoskeletal pain (25%), and chronic regional pain syndrome/reflex sympathetic dystrophy (CRPS/RSD) (35%) (Table 3).

Table 3. Participant data and demographic information.

Age		Mean: 14.05 years	(SD: 2.892 years)
		n	%
Gender			
	Male	5	25%
	Female	15	75%
Race/Ethnicity			
	Caucasian	19	95%
	African American	1	5%
Primary Diagnosis			
	Musculoskeletal	5	25%
	CRPS/RSD	7	35%
	Functional Abdominal Pain	1	5%
	Headache	6	30%
	Other	1	5%

Intervention

Pediatric Pain Rehabilitation Center

This study took place at the Mayo Family PPRC at Boston Children's Hospital in Waltham. This is an intensive day treatment rehabilitation program for children and adolescents between the ages of eight and eighteen. Children arrive at 8:00am and stayed until 4:00pm, five days a week, for an average of four weeks. Their days consist of individual and group sessions of physical therapy, occupational therapy, psychological therapy, and nursing and medical attention. Evaluations and assessments are done on the first day with each specialist in order to create a personalized program. Children are encouraged to be social with one another as they eat lunch together every day. During their lunchtime, the staff has meetings to go over each child's progress (PPRC, 2016).

Many parents enter the program discouraged and in distress (Gaughan, Logan, Sethna, & Mott, 2014), so parental support is also provided throughout their time at the PPRC. Gaughan and colleagues (2014) have found that by incorporating parents in the rehabilitation process has helped them gain confidence in themselves and learn skills to help their child cope with the pain. At least once a week parents join their child with their psychologists to participate in family therapy. They are encouraged to watch their child work with both the physical and occupational therapist. Weekly, parents attend a support group session with one of the psychologists, as well as a mandatory education class on Wednesday afternoons with a specialist from each discipline present (PPRC, 2016).

Measures

Pain Sensitivity Questionnaire

In order to evaluate pain sensitivity, we administered the PSQ (Ruscheweyh et al., 2012) to both parents and children prior to admission and discharge from the PPRC. The PSQ contains seventeen questions that ask the recipient to answer from a scale of zero, being no pain, to ten, being the worst pain imaginable (Figure 3). Each question requires the participants to put themselves in the situation of the question prior to answering. This is an easy way to measure pain sensitivity, as it does not require any equipment or administration from a staff member.

Both parents and children use paper and pencil to fill out the PSQ (Figure 3) at admission and discharge. At admission, the PSQ is mailed to the household to be filled out before they come in, but if they have not, they do so on the first day at the PPRC. At discharge, the PSQ is filled out during the last week at the PPRC before they leave to go home.

Psychosocial Variables

Pain intensity. At admission and discharge children were asked to rate their current level of pain followed by a usual level of pain on an eleven-point scale from zero (no pain) to ten (most pain possible) (von Baeyer et al., 2009).

Functional disability. The Functional Disability Inventory (FDI) (Walker & Greene, 1991) is a child self-reported measure determining challenges in physical and psychosocial functioning due to their physical health. The child is asked to answer fifteen questions in regards to their perceived ability within the past two weeks on a scale from

Pain Sensitivity Questionnaire

1. Imagine you bump your shin badly on a hard edge, for example, on the edge of a glass coffee table.

0 = not at all painful 10 = most severe pain imaginable
0 ----- 1 ----- 2 ----- 3 ----- 4 ----- 5 ----- 6 ----- 7 ----- 8 ----- 9 ----- 10

2. Imagine you burn your tongue on a very hot drink.

3. Imagine your muscles are slightly sore as the result of physical activity.

4. Imagine you trap your finger in a drawer.

5. Imagine you take a shower with lukewarm water.

6. Imagine you have mild sunburn on your shoulders.

7. Imagine you grazed your knee falling off your bicycle.

8. Imagine you accidentally bite your tongue or cheek badly while eating.

9. Imagine you walking across a cool tiled floor with bare feet.

10. Imagine you have a minor cut on your finger and inadvertently get lemon juice in the wound.

11. Imagine you prick your fingertip on the thorn of a rose.

12. Imagine you stick your bare hands in the snow for a couple of minutes or bring your hands in contact with snow for some time, for example, while making snowballs.

13. Imagine you shake hands with someone who has a normal grip.

14. Imagine you shake hands with someone who has a very strong grip.

15. Imagine you pick up a hot pot by inadvertently grabbing its equally hot handles.

16. Imagine you are wearing sandals and someone with heavy boots steps on your foot.

17. Imagine you bump your elbow on the edge of a table ("funny bone").

Figure 3. Pain Sensitivity Questionnaire. Adapted from Ruscheweyh et al. (2012)

"no trouble" to "impossible." The scores are summed, with greater scores indicating the child's perceived functional disability.

Pain-related fear. The Fear of Pain Questionnaire, child and parent (FOPQ-C; FOPQ-P) (Simons, Sieberg, Carpino, Logan, & Berde, 2011) estimates child and parent perceptions of child pain-related fears and avoidance behaviors. It is measured on a five-point scale with zero meaning strongly disagree and five meaning strongly agree. The FOPQ-C consists of 24 item, while the FOPQ-P consists of 23.

Catastrophizing. The Pain Catastrophizing Scale, child (PSC-C) (Crombez et al., 2003) measures emotions children experience of their own pain. The Pain Catastrophizing Scale, parent (PSC-P) (Goubert, Eccleston, Vervoort, Jordan, & Crombez, 2006) measures the emotions parents experience while their child is in pain. Both are measured on a five-point scale with zero being "not at all" and four being "extremely." The scores are summed, with greater scores indicating heightened catastrophic thinking.

RESULTS

Aim 1

Eighteen mothers, nine fathers, and nineteen children completed the PSQ at admission. Thirteen mothers, nine fathers, and fourteen children completed the PSQ at discharge (Table 4). This is a pilot sample. Data collection is ongoing. Table 4 describes minimum, maximum, mean, and standard deviation for PSQ scores at two time points. Father's scored highest on the PSQ Moderate at discharge and child scored lowest on the PSQ minor at admission (Table 4).

Table 4. PSQ means and standard deviations separated by family member.

Surveys	Pre			Post		
	N	Mean	Std. Deviation	N	Mean	Std. Deviation
PSQ_Minor						
Mother	18	3.54	2.33	13	3.29	1.80
Father	9	3.97	2.16	9	3.94	1.65
Child	18	2.86	1.69	14	3.26	1.82
PSQ_Moderate						
Mother	18	5.00	2.43	13	5.18	2.32
Father	9	5.41	2.04	9	5.78	1.83
Child	19	4.35	1.72	14	4.55	1.92
PSQ_Total						
Mother	18	4.43	2.32	13	4.38	2.12
Father	9	4.80	2.02	9	4.98	1.72
Child	19	3.74	1.65	14	4.04	1.83

Twenty mothers, thirteen fathers, and twenty children completed the psychological variable surveys at admission. Fourteen children and five fathers completed the psychological variable surveys at discharge. Eleven mothers completed the FOPQ and twelve completed the PCS at discharge (Table 5). Table 5 presents mean and standard deviation of the psychosocial variables measured in child, mother, and father at

two time points. There was an overall decrease from admission to discharge for mother, father, and child in FOPQ and PCS. There was also an overall decrease from admission to discharge for all additional child measures (Table 5). Father FOPQ score was highest at admission and child PCS score was lowest at discharge.

Table 5. Measures of psychosocial variable separated by family member.

Surveys	**Pre**			**Post**		
	N	**Mean**	**Std. Deviation**	**N**	**Mean**	**Std. Deviation**
FOPQ_Total						
Mother	20	32.55	13.06	11	18.91	13.87
Father	13	32.77	11.83	5	29.00	17.58
Child	20	42.25	17.46	14	25.50	18.02
PCS						
Mother	20	28.15	10.31	12	17.92	13.94
Father	13	30.31	9.27	5	22.20	11.86
Child	20	23.10	12.15	14	17.50	12.26
Additional Child						
FDI_Total	20	24.05	10.81	14	10.71	6.79
Current Pain	20	6.55	2.33	14	4.86	2.77
Usual Pain	20	6.60	1.73	14	5.86	2.14

Aim 2

Table 6 exhibits the bivariate correlations, which are quantitative analyses of multiple variables to determine their relationship (Gigliotti, E.), for 34 PSQ and psychosocial variables. Mother PSQ minor, PSQ moderate, and PSQ total at admission were positively correlated with child PSQ moderate and child PSQ total at admission. Father PSQ scores at admission had no correlation with child PSQ scores at admission or discharge. Child PSQ minor at admission was positively correlated with both mother and

Table 6. Correlations for mother, father, and child PSQ and child pain ratings at admission and discharge.

Variable	2	3	4	5	6	7	8	9	10	11	12
1. mPSQ_Minor_pre	**0.94****	**0.98****	**0.68***	**0.69***	**0.70***	0.48	**0.56***	**0.55***	-0.11	0.2	**0.77****
2. mPSQ_Moderate_pre	1	**0.99****	**0.73***	**0.78***	**0.79***	0.43	**0.55***	**0.52***	-0.58	0.25	**0.90****
3. mPSQ_Total_pre		1	**0.73***	**0.77***	**0.77***	0.48	**0.57***	**0.55***	-0.07	0.22	**0.86****
4. fPSQ_Minor_pre			1	**0.97****	**0.99****	0.49	0.58	0.51	-0.35	0.35	-0.17
5. fPSQ_Moderate_pre				1	**1****	0.44	0.54	0.48	-0.31	0.17	-0.05
6. fPSQ_Total_pre					1	0.45	0.56	0.5	-0.32	0.25	-0.05
7. cPSQ_Minor_pre						1	**0.82****	**0.94****	0.16	0.2	**0.74****
8. cPSQ_Moderate_pre							1	**0.96****	0.04	0.1	**0.76****
9. cPSQ_Total_pre								1	-0.01	0.19	**0.78****
10. CurrentPain_ pre									1	0.41	0.3
11. UsualPain_pre										1	0.25
12. mPSQ_Minor_post											1
13. mPSQ_Moderate_post											
14. mPSQ_Total_post											
15. fPSQ_Minor_post											
16. fPSQ_Moderate_post											
17. fPSQ_Total_post											
18. cPSQ_Minor_post											
19. cPSQ_Moderate_post											
20. cPSQ_Total_post											
21. CurrentPain_post											
22. UsualPain_post											

Variable	13	14	15	16	17	18	19	20	21	22
1. mPSQ_Minor_pre	**0.70***	**0.75****	**0.79***	0.74	**0.82***	0.29	0.49	0.44	0.01	0.35
2. mPSQ_Moderate_pre	**0.87****	**0.9****	0.51	0.58	0.6	0.39	**0.59***	0.54	0.16	0.51
3. mPSQ_Total_pre	**0.82****	**0.86****	0.63	0.64	0.68	0.36	0.55	0.51	0.12	0.46
4. fPSQ_Minor_pre	-0.42	-0.28	0.12	-0.02	0.03	0.18	-0.11	-0.01	-0.34	-0.44
5. fPSQ_Moderate_pre	-0.21	-0.12	-0.04	-0.19	-0.11	0.14	-0.11	-0.02	-0.48	-0.58
6. fPSQ_Total_pre	-0.24	-0.14	0.02	-0.12	-0.05	0.19	-0.08	0.02	-0.48	-0.57
7. cPSQ_Minor_pre	**0.71****	**0.74****	**0.88****	**0.86****	**0.88****	**0.87****	**0.83****	**0.90****	0.08	0.16
8. cPSQ_Moderate_pre	**0.66***	**0.72****	**0.75***	**0.73***	**0.77***	**0.66***	**0.81****	**0.78****	-0.01	0.09
9. cPSQ_Total_pre	**0.69***	**0.75****	**0.80***	**0.76***	**0.81***	**0.77****	**0.84****	**0.86****	0.04	0.11
10. CurrentPain_ pre	**0.59***	0.47	-0.11	-0.16	-0.11	0.36	0.13	0.22	**0.62***	**0.69***
11. UsualPain_pre	0.43	0.38	-0.3	-0.17	-0.07	0.25	0.13	0.18	**0.67****	**0.62***
12. mPSQ_Minor_post	**0.90****	**0.97****	0.51	0.62	0.61	**0.75****	**0.86****	**0.86****	-0.02	0.25
13. mPSQ_Moderate_post	1	**0.98****	0.42	0.5	0.5	**0.76****	**0.68****	**0.74****	0.26	0.51
14. mPSQ_Total_post		1	0.47	0.57	0.57	**0.77****	**0.78****	**0.81****	0.14	0.4
15. fPSQ_Minor_post			1	**0.95****	**0.99****	0.42	0.5	0.49	-0.48	-0.35
16. fPSQ_Moderate_post				1	**0.98****	0.62	**0.70***	**0.69***	-0.53	-0.36
17. fPSQ_Total_post					1	0.54	0.62	0.61	-0.51	-0.36
18. cPSQ_Minor_post						1	**0.83****	**0.93****	0.03	0.17
19. cPSQ_Moderate_post							1	**0.97****	-0.23	-0.03
20. cPSQ_Total_post								1	-0.13	0.06
21. CurrentPain_post									1	**0.89****
22. UsualPain_post										1

*p<0.05

**p<0.01

father PSQ minor, PSQ moderate, and PSQ total all at discharge. Child PSQ moderate at admission was positively correlated with both mother and father PSQ minor, PSQ moderate, and PSQ total all at discharge. Child PSQ total at admission was positively correlated with both mother and father PSQ minor, PSQ moderate, and PSQ total all at discharge. Mother PSQ minor at discharge was positively correlated with child PSQ minor, PSQ moderate, and PSQ total at discharge. Mother PSQ moderate at

discharge was positively correlated with child PSQ minor, PSQ moderate, and PSQ total at discharge. Mother PSQ total at discharge was positively correlated with child PSQ minor, PSQ moderate, and PSQ total at discharge. Father PSQ moderate at discharge was only positively correlated with child PSQ moderate and PSQ total at discharge. Mother PSQ moderate scores at discharge positively correlated with child level of current pain when asked at admission. There are many positive correlations between PSQ scores among mother, father, and child, but no such correlations occur with FOPQ, PCS, FDI, or child usual pain ratings.

Aim 3

Repeated measure ANOVAs were performed to determine between-group effects at admission and discharge. PSQ minor scores decreased for both mother and father, but increased for child from admission to discharge; however, there was no main effect for time indicating that these changes from admission to discharge were not significant (Figure 4). PSQ moderate scores increased for mother, father, and child from admission to discharge (Figure 5). PSQ total scores decreased for mother, but increased for father and child from admission to discharge, but again there was no main effect for time indicating that these changes were not significant (Figure 6). However, PSQ minor scores begin to approach statistical significance at 0.06 (Table 7). The psychological variables were not included in the model since there were no significant correlations.

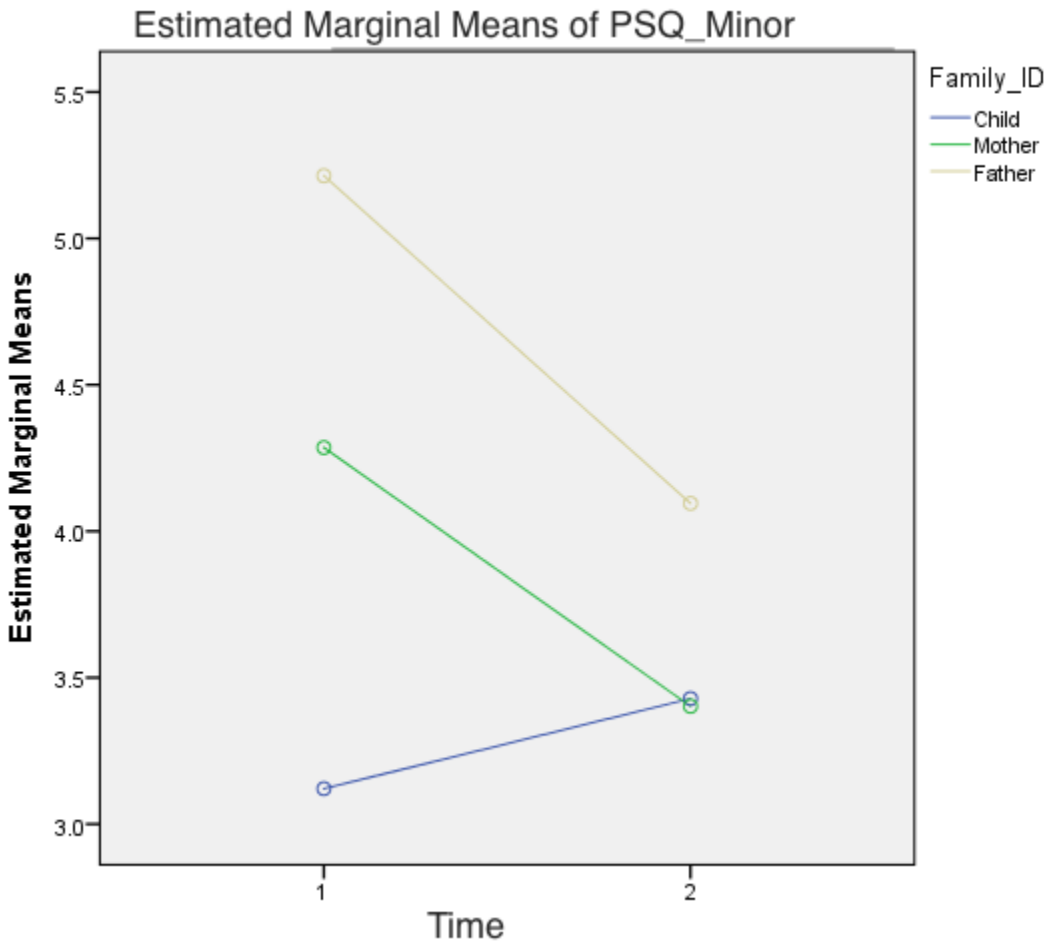

Figure 4. Estimated marginal means of PSQ_Minor for child, mother, and father at admission and discharge.

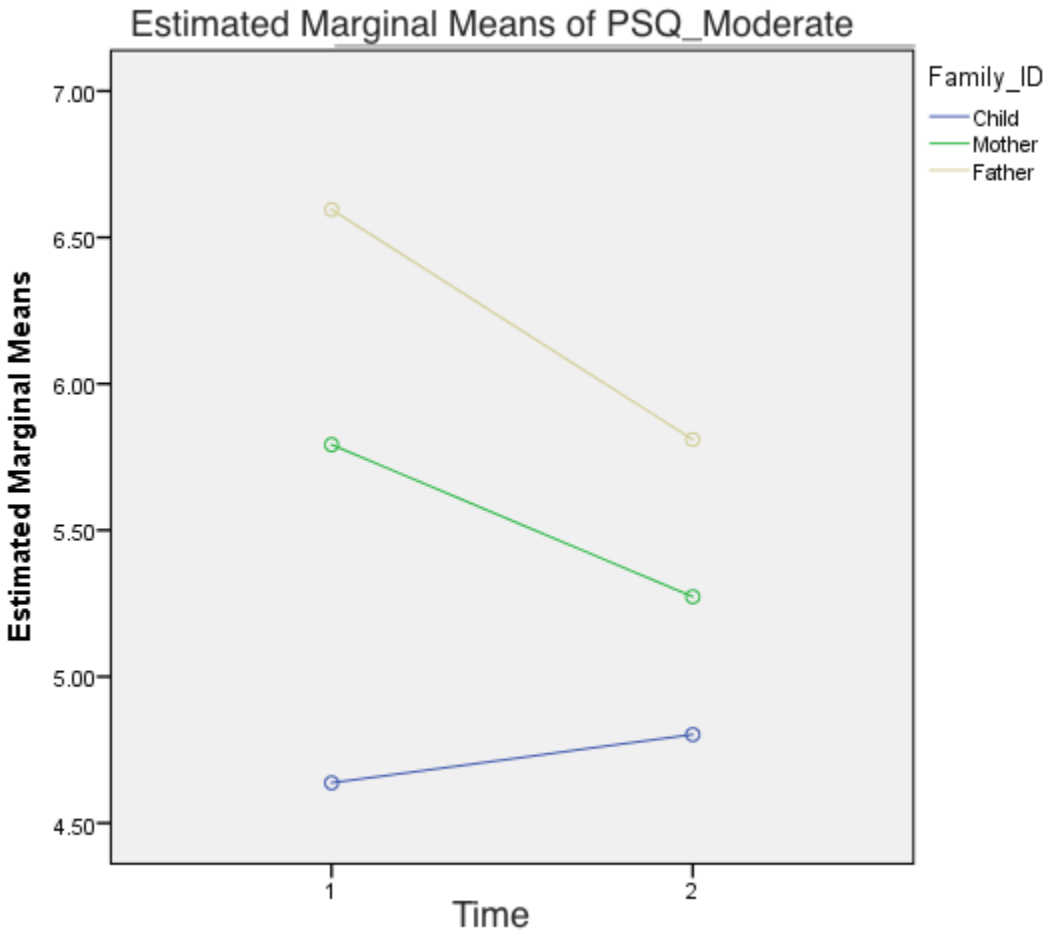

Figure 5. Estimated marginal means of PSQ_Moderate for child, mother, and father at admission and discharge.

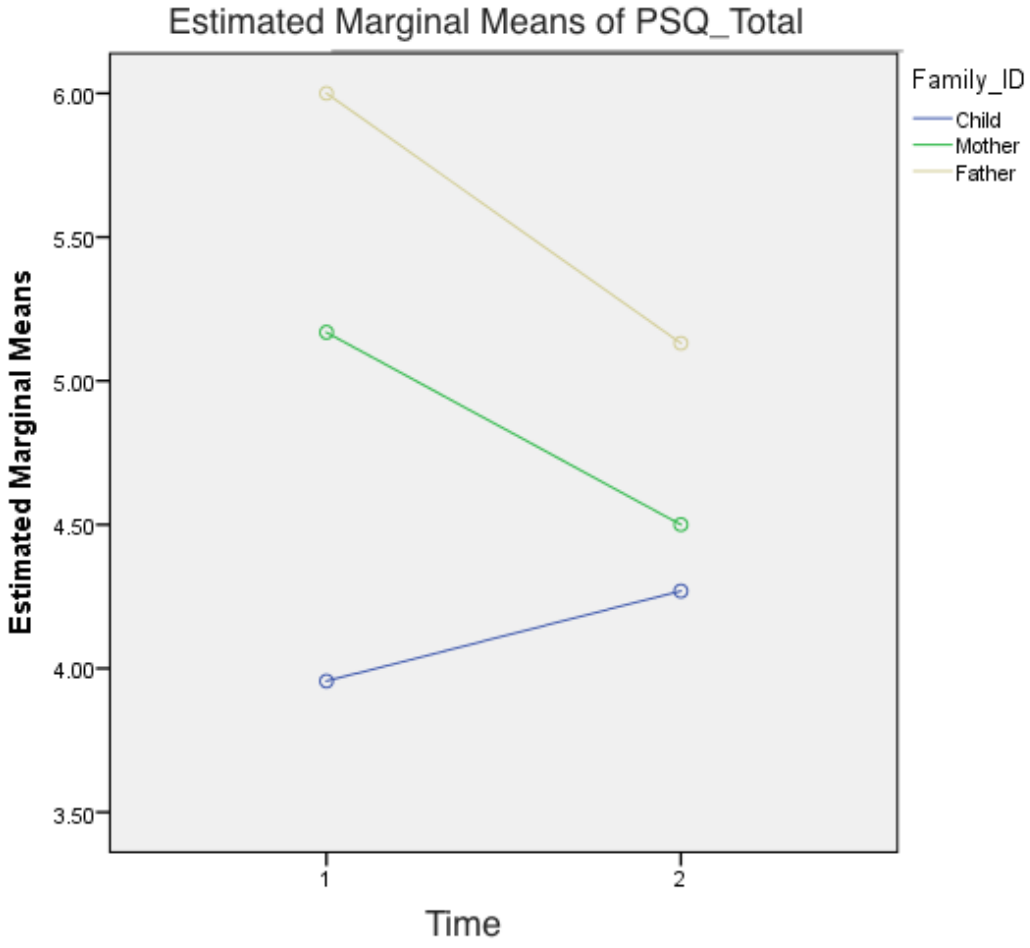

Figure 6. Estimated marginal means of PSQ_Total for child, mother, and father at admission and discharge.

Table 7. Statistical significance of PSQ Scores.

Variable	Df	F	p
PSQ_Total Subscale Score	1,27		
-Main effect for time		2.34	n.s.
-Time x Parent Interaction		2.17	n.s.
PSQ_Minor Subscale Score	1,27		
-Main effect for time		4.02	0.06
-Time x Parent Interaction		2.85	0.08
PSQ_Moderate Subscale Score	1,27		
-Main effect for time		1.72	n.s.
-Time x Parent Interaction		1.05	n.s.

DISCUSSION

This study aimed to contribute to the expanding research body on pediatric chronic pain. Specifically, how parental and child pain sensitivity are related and relate to pain and psychosocial functioning at admission to discharge for youth with chronic pain enrolled in an intensive pain rehabilitation was explored. Change in pain sensitivity from admission to discharge was also explored. There were many findings from this study.

First, we had predicted that pain sensitivity and psychosocial measures would decrease from admission to discharge for mother, father, and child. All of the PSQ and psychosocial variables decreased from admission to discharge among the three groups, which is consistent with the literature (Simons et al., 2013; Logan et al., 2012). Children and adolescents at the PPRC are taught desensitization techniques, while parents are more focused on targeting catastrophizing, fear of pain, and avoidance of pain. Parents do have the opportunity to observe several physical and occupational therapy sessions per week and watch their child do the Home Exercise Program each night (PPRC, 2016), so we would assume they are learning these desensitization techniques as well.

Both mother and father FOPQ scores at admission were within one point of one another, yet at discharge mother scores were almost half that at admission and father scores had only gone down by three points. Similarly this can be seen in mother and father PCS scores. Many studies comparing parental responses to their child's chronic pain show mothers catastrophizing more than that of fathers (Hechler et al., 2011; Goubert, Vervoort, Sullivan, Verhoeven, & Crombez, 2008). This could be that perhaps fathers are not present at the PPRC as often as mothers are, and are thus not learning the

same techniques. As many patients travel far to participate at the PPRC, one parent will stay home to work. Usually the mother accompanies the child to the PPRC and they are usually the ones communicating with healthcare professionals (Macfadyen, Swallow, Santacroce, & Lambert, 2011). But fathers have been found to have increased levels of stress and distress when they are the primary caregiver for a child with chronic pain (Bonner, Hardy, Willard & Hutchinson, 2007). This shows the importance of targeting both parents in such an intervention.

Second, we had predicted that there would be a correlation with the psychosocial measures and pain sensitivity. A bivariate correlation matrix was run for the psychosocial variables against all PSQ measures, but no positive correlations were found. It is unclear as to why this is the case as it is expected that catastrophizing and fear of pain, which is driven by avoidance (Caes et al., 2011), would be related to pain sensitivity. People who pain catastrophize more may perceive the situations presented in the PSQ as awful. Although it has been tested that these measures all related, perhaps they are in fact different entities and therefore they must be treated separately.

There is a high correlation with mother and father PSQ scores at admission (Table 5). There is a high correlation between mother and child PSQ scores at admission and discharge while not the same can be seen between father and child PSQ scores. This calls into question whether the parents are being influenced by their child's pain or whether this is enmeshment (i.e. lack of independence within a familial construct). Enmeshment is positively correlated with child functional disability, as children with chronic pain in

families with high enmeshment are less likely to become independent and thus prolonging chronic pain state (Logan & Shraff, 2005; Lewandowski et al., 2010).

Our final hypothesis was that parents would improve their pain sensitivity due to their exposure at the PPRC. Although there was some improvement over time in mothers and fathers, these changes were not statistically significant and overall, they still scored much higher overall than healthy controls. On average a healthy control scores 3.4 on PSQ total and 2.2 on PSQ minor (Ruscheweyh et al., 2012). Father PSQ minor scores at discharge were higher than those of healthy controls, whereas mother scores were lower. On the other hand, both mother and father PSQ total scores at discharge were more than double the scores of healthy controls.

Chronic pain has been found to run in families (Evans et al., 2008; Laurell, Larsson, & Eeg-Olofsson, 2005; Lynch et al., 2006; Schanberg et al., 2001), and those with chronic pain are influenced by the behaviors of the people who surround them (Vowles, Cohen, McCracken, & Eccleston, 2010). As children observe their parents in pain or not coping with the pain, they are more likely to mimic this behavior and report similar pain (Bruehl et al., 2005), thus having a negative impact on their therapy outcomes. These findings indicate a need to target parents' own pain and sensitivity issues due to social modeling.

One-way, repeated measures ANOVA were conducted to assess whether pain sensitivity can change for parents and children from admission to discharge. However, contrary to our hypothesis, child PSQ minor, PSQ moderate, and PSQ total scores all increased between the two time points. The ANOVA showed no significant difference

between mothers and fathers as they both follow the same trend (Figure 4, 5, & 6). There was no significant main effect for time for the children or the parents and both children and parents do not perceive a change in their pain sensitivity from admission to discharge. It is unclear as to why there was no significant change in pain sensitivity as there is extensive physical and occupational therapy the children and adolescents experience at their time at the PPRC. Goals of physical and occupational therapy largely focus on desensitization (i.e. wearing different shoes, rubbing different textures over the sensitive limb, rubbing lotion on the sensitive limb) in order to re-educate the nervous system, which also targets fear of pain (PPRC, 2016).

The PSQ moderate and PSQ total ANOVA shows that there was no change over time in all three variables, although it does seem as though parents are doing better than the child (Figure 4 & 6). The PSQ Minor scores did show an approach to statistical significance ($p=0.055$) (Table 7). There is an approaching trend, which may be better seen in a larger sample. With a larger sample it will be interesting to see whether there is a main effect for time, meaning statistically significant changes from admission to discharge. Although improvement is not evident at discharge, there is a need to look at potential changes in pain sensitivity longitudinally. Families return to the PPRC for follow-up appointments at 1, 6, and 12-month post-discharge (PPRC, 2016) so future research should administer these measures at those time-points to see whether long-term change in pain sensitivity is possible.

A future direction of this research would be first to validate the PSQ within a child sample. Although the PSQ (Ruscheweyh et al., 2012) proves to be a valid tool for

discerning pain sensitivity in adults, it has been studied that differences in pain sensitivity occur not only between genders, but also across age groups (Crombez et al, 2003). Another future direction would be to look at pain genetics. The high pain sensitivity in mothers and fathers of our sample compared to healthy controls could be due to the fact that they have children with chronic pain, agreeing with studies that have found a heritability component in pain sensitivity. An additional future direction would be to look at social modeling and the influence of family dynamics due to the high correlations in PSQ scores were found between mothers and children and mothers and fathers. This could be because the child is modeling after the mother more than after the father, that the parents are being influenced by their child's pain, or that the parents themselves have their own sensitivity issues. Finally, treatment implications need to incorporate more sensory testing within the intervention rather than focusing more on psychosocial measures.

This study should still be considered despite its limitations. As this was a pilot study, the sample was under-powered. As this study is ongoing and looking at participants at the PPRC, discharge data was only available for the ones that had graduated from the program. A larger sample size is warranted to further explore how these variables are related. There was also no baseline comparison to the parents and children in this study. Although PSQ scores could be found for adult healthy controls, we were not able to have a similar comparison for the children in this study. This is due to the PSQ not having been validated within a child cohort. The lack of this validated measure could explain the increase in child PSQ scores from admission to discharge. The

children and adolescents may not have been appropriately interpreting the questions on the PSQ. Pain is an abstract thought, and as this is a self-administered questionnaire, there could have been some misunderstanding. Despite these limitations, these findings contribute to the current pain field, addressing a need to add to and/or change treatment for pain sensitivity.

REFERENCES

American Pain Society Task Force on Pediatric Chronic Pain Management. (2012). *Assessment of management of children with chronic pain: A position statement from the american pain society.* Retrieved 01/12, 2016, from http://americanpainsociety.org/uploads/get-involved/pediatric-chronic-pain-statement.pdf

Anttila, P., Metsahonkala, L., Helenius, H., & Sillanpaa, M. (2000). Predisposing and provoking factors in childhood headache. *Headache: The Journal of Head and Face Pain, 40*(5), 351-356.

Arnold, L. M., Hudson, J. I., Hess, E. V., Ware, A. E., Fritz, D. A., Auchenbach, M. B., et al. (2004). Family study of fibromyalgia. *Arthritis and Rheumatism, 50*(3), 944-952.

Aromaa, M., Rautava, P., Helenius, H., & Sillanpää, M. L. (1998). Factors of early life as predictors of headache in children at school entry. *Headache: The Journal of Head and Face Pain, 38*(1), 23-30.

Aromaa, M., Sillanpää, M. L., Rautava, P., & Helenius, H. (2000). Pain experience of children with headache and their families: A controlled study. *Pediatrics, 106*(2pt1), 270-275.

Boey, C., & Goh, K. I. (2001). Predictors of recurrent abdominal pain among 9to 15-year-old urband school-children in malaysia. *Acta Paediatrica, 90*(3), 353-355.

Bonner, M. J., Hardy, K. K., Willard, V. W., & Hutchinson, K. C. (2007). Psychosocial functioning of fathers as primary caregivers of pediatric oncology patients. *Journal of Pediatric Psychology, 32*, 851-856.

Boston Children's Hospital. (2016). *Pediatric pain rehabilitation center overview.* Retrieved 01/10, 2016, from http://www.childrenshospital.org/centers-and-services/pediatric-pain-rehabiliation-center-program

Bruehl, S., France, C. R., France, J., Harju, A., & al'Absi, M. (2005). How accurate are parental chronic pain histories provided by offpspring? *Pain, 115*(3), 390-397.

Caes, L., Vervoort, T., Eccleston, C., Vandenhende, M., & Goubert, L. (2011). Parental catastrophizing about Child's pain and its relationship with activity restriction: The mediating role of parental distress. *Pain, 152*(1), 212-222.

Carter, B. D., & Threlkeld, B. M. (2012). Psychosocial perspectives in the treatment of pediatric chronic pain. *Pediatric Rheumatology Online Journal, 10*(1), 10-15.

Celedon, X., Amari, A., Ward, C. M., Prestwich, S., & Slifer, K. J. (2014). Children and adolescents with chronic pain and functional disability: Use of a behavioral rehabilitation approach. *Current Physical Medicine and Rehabilitation Report, 2*(2), 86-92.

Crombez, G., Bijttebier, P., Eccleston, C., Mascagni, T., Mertens, G., & Goubert, L., et al. (2003). The child version of the pain catastrophizing scale (PCS-C): A preliminary validation. *Pain, 104,* 639-646.

Eccleston, C., & Crombez, G. (2007). Worry and chronic pain: A misdirected problem solving model. *Pain, 132*(3), 233-236.

Eccleston, C., Crombez, G., Scotford, A., Clinch, J., & Connell, H. (2004). Adolescent chronic pain: Patterns and predictors of emotional distress in adolescents with chronic pain and their parents. *Pain, 108*(3), 221-229.

Emiroğlu, F. N. I., Kurul, S., Akay, A., Miral, S., & Dirik, E. (2004). Assessment of child neurology outpatients with headache, dizziness, and fainting. *Journal of Child Neurology, 19*(5), 332-336.

Evans, S., Keenan, T. R., & Shipton, E. A. (2007). Psychosocial adjustment and physical health of children living with maternal chronic pain. *Journal of Pediatrics and Child Health, 43*(4), 262-270.

Evans, S., Tsao, J. C. I., Lu, Q., Myers, C., Suresh, J., & Zeltzer, L. K. (2008). Parent-child pain relationships from a psychosocial perspective:
A review of the literature. *Journal of Pain and Symptom Management, 1*(3), 237-246.

Gaskin, D. J., & Richard, P. (2011). The economic costs of pain in the United States. In Institute of Medicine Committee on Advancing Pain Research, Care, and Education. (Ed.), *Relieving pain in America: A blueprint for transforming prevention, care, education, and research.* (pp. 301-337). Washington D.C.: National Academies Press.

Gaughan, V., Logan, D., Sethna, N., & Mott, S. (2014). Parents' perspective of their journey caring for a child with chronic neuropathic pain. *Pain Management Nursing, 15*(1), 246-257.

Gauntlett-Gilbert, J., & Eccleston, C. (2007). Disability in adolescents with chronic pain: Patterns and predictors across different domains of functioning. *Pain, 131*(1), 132-141.

Geraghty, M. E. A., & Busem, D. C. (2015). The biopsychosocialspiritual impact of chronic pain, chronic illness, and physical disabilities in adolescence. *Current Pain Headache Reports, 19*(51)

Gigliotti, E. (2007). Discovering statistics using SPSS. *Journal of Advanced Nursing, 58*(3), 303.

Goodman, J. E., & McGrath, P. J. (1991). The epidemiology of pain in children and adolescents: A review. *Pain, 46*(3), 247-264.

Goubert, L., Eccleston, C., Vervoort, T., Jordan, A., & Crombez, G. (2006). Parental catastrophizing about their child's pain: The parent version of the pain catastrophizing scale. *Pain, 123*(3), 254-263.

Goubert, L., Vervoort, T., SUllivan, M. J. L., Verhoeven, K., & Crombez, G. (2008). Parent emotional responses to their child's pain: The role of dispositional empathy and catastrophizing about their child's pain. *Journal of Pain, 9*(3), 272-279.

Granot, M., Khoury, R., Berger, G., Krivoy, N., Braun, E., Aronson, D., et al. (2007). Clinical and experimental pain perception is attenuated in patients with painless myocardial infarction. *Pain, 133*(1-3), 120-127.

Guite, J. W., Logan, D. E., Sherry, D. D., & Rose, J. B. (2007). Adolescent self-perception: Associations with chronic musculoskeletal pain and functional disability. *Journal of Pain, 8*(5), 379-386.

Hechler, T., Vervoort, T., Hamann, M., Tietze, A. L., Vocks, S., Goubert, L., et al. (2011). Parental catastrophizing about their Child's chronic pain: Are mothers and fathers different? *European Journal of Pain, 15*(5), 515.e1-515.e9.

Higgins, K. S., Birnie, K. A., Chambers, C. T., Wilson, A. C., Caes, L., Clark, A. J., et al. (2015). Offspring of parents with chronic pain: A systematic review and meta-analysis of pain, health, psychological, and family outcomes. *Pain, 156*(11), 2256-2266.

Kashikar-zuck, S., Lynch, A. M., Slater, S., Graham, T. B., Swain, N. F., & Noll, R. B. (2008). Family factors, emotional functioning, and functional impairment in juvenile fibromyalgia syndrome. *Arthritis and Rheumatism, 59*(10), 1392-1398.

Kim, H. J., Lee, J. I., Kang, K. T., Chang, B. S., Lee, C. K., Ruscheweyh, R., et al. (2015). Influence of pain sensitivity on surgical outcomes after lumbar spine surgery in patients with lumbarspinal stenosis.*Spine, 40*(3), 193-200.

Kim, H. J., Suh, B. G., Lee, D. B., Lee, G. W., Kim, D. W., Kang, K. T., et al. (2013). The influence of pain sensitivity on the symptom severity in patients with lumbar spinal stenosis. *Pain Physician, 16*(2), 135-144.

Knutti, I. A., Suter, M. R., & Opsommer, E. (2014). Test-retest reliability of thermal quantitative sensory testing on two sites within the L5 dermatome of the lumbar spine and lower extremity. *Neuroscience Letters, 579*, 157-162.

Laurell, K., Larsson, B., & Eeg-Olofsson, O. (2005). Headache in school children: Association with other pain, family history, and psychosocial factors. *Pain, 119*(1), 150-158.

Lewandowski, A. S., Palermo, T. M., Stinson, J., Handley, S., & Chambers, C. T. (2010). Systemic review of family functioning in families of children and adolescents with chronic pain. *The Journal of Pain, 11*(11), 1027-1038.

Logan, D. E., Carpino, E. A., Chiang, G., Condon, M., Firn, E., Gaughan, V. J., et al. (2012). A day hospital approach to treatment of pediatric complex regional pain syndrome: Initial functional outcomes. *Clinical Journal of Pain, 28*(9)

Logan, D. E., & Schraff, L. (2005). Relationships between family and parent characteristics and functional abilities in children with recurrent pain syndromes: An investigation of moderating effects on the pathway from pain to disability. *Journal of Pediatric Psychology*, *30*(8), 698-707.

Logan, D. E., Simons, L. E., & Carpino, E. A. (2012). Too sick for school? parent influences on school functioning among children with chronic pain. *Pain, 153*(2), 437-443.

Lynch, A. M., Kashikar-Zuck, S., Goldschneider, K. R., & Jones, B. A. (2006). Psychosocial risks for disability in children with chronic back pain. *Journal of Pain, 7*(4), 244-251.

Macfadyen, A., Swallow, V., Santacroce, S., & Lambert, H. (2011). Involving fathers in research. *Journal for Specialists in Pediatric Nursing, 16*(3), 216-219.

Maynard, C. S., Amari, A., Wieczorek, B., Christensen, J. R., & Slifer, K. J. (2010). Interdisciplinary behavioral rehabilitation of pediatric pain-associated disability: Retrospective review of an inpatient treatment protocol. *Journal of Pediatric Psychology, 35*(2), 128-137.

Moloney, N. A., Hall, T. M., & Doody, C. M. (2012). Reliability of thermal quantitative sensory testing: A systemic review. *Journal of Rehabilitation Research and Development, 49*(2), 191-208.

Nielsen, C. S., Staud, R., & Price, D. D. (2009). Individual differences in pain sensitivity: Measurement, causation, and consequences. *Journal of Pain, 10*(3), 231-237.

Nielsen, C. S., Stubhaug, A., Price, D. D., Vassend, O., Czajkowski, N., & Harris, J. R. (2008). Individual differences in pain sensitivity: Genetic and environmental contributions. *Pain, 136*(1), 21-29.

O'Neill, S., & O'Neill, L. (2015). Improving QST reliability - more raters, tests or occasions? A multivariate generalizability study. *The Journal of Pain, 16*(5), 454-462.

Osbome, R. B., hatcher, J. W., & Richtsmeier, A. J. (1989). The role of social modeling in unexplained pediatric pain. *Journal of Pediatric Psychology, 14*(1), 43-61.

Palermo, T., Eccleston, C., Lewandowski, A. S., Williams, A. C. C., & Morley, S. (2010). Randomized controlled trials of psychological therapies for management of chronic pain in children and adolescents: An updated meta-analytic review. *Pain, 143*(3), 387-397.

Palermo, T. M., & Chambers, C. T. (2005). Parent and family factors in pediatric chronic pain and disability: An integrative approach. *Pain, 119*(1), 1-4.

Palermo, T. M., & Eccleston, C. (2009). Parents of children and adolescents with chronic pain. *Pain, 146*(1), 15-17.

Palermo, T. M., Valrie, C. R., Karlson, C. W., & Anderson, N. B. (2014). Family and parent influences on pediatric chronic pain. *American Psychologist, 69*(2), 142-152.

Pediatric pain rehabilitation center overview. (2016). Retrieved 01.10, 2016, from http://www.childrenshospital.org/centers-and-services/pediatric-pain-rehabiliation-center-program

Perquin, C. W., Hazebroek-Kampschreue, A., Hunfeld, J., Bohnen, A. M., van Suijlekom-Smit, L., Passchier, J., et al. (2000). Pain in children and adolescents: A common experience. *Pain, 87*(1), 51-58.

Rolke, R., Magerl, W., Campbell, K. A., Schalber, C., Caspari, S., Birklein, F., et al. (2006). Quantitative sensory testing: A comprehensive protocol for clinical trials. *European Journal of Pain, 10*(1), 77-88.

Roth-Isigkeit, A., Thyen, U., Stoven, H., Schwarzenberger, J., & Schmucker, P. (2005). Pain among children and adolescents: Restrictions in daily living and triggering factors. *Pediatrics, 115*(2), e152-162.

Ruscheweyh, R., Marziniak, M., Stumoenhorst, F., Reinholz, J., & Knecht, S. (2009). Pain sensitivity can be assessed by self-rating: Development and validation of the pain sensitivity questionnaire. *Pain, 146*(1), 65-74.

Ruscheweyh, R., Verneuer, B., Dany, K., Marziniak, M., Wolowski, A., Çolak-Ekici, R., et al. (2012). Validation of the pain sensitivity questionnaire in chronic pain patients. *Pain, 153*(6), 1210-1218.

Saundm, K., Korff, M. V., Leresche, L., & Manci, L. (2007). Relationship of common pain conditions in mothers and children. *Clinical Journal of Pain, 23*(3), 204-213.

Schanberg, L. E., Anthony, K. K., Gil, K. M., Lefebvre, J. C., Kredich, D. W., & Macharoni, L. M. (2001). Family pain history predicts child health status in children with chronic rheumatic disease. *Pediatrics, 108*(3)

Sieberg, C. B., Williams, S., & Simons, L. E. (2011). Do parent protective responses mediate the relation between parent distress and child functional disability among children with chronic pain? *Journal of Pediatric Psychology, 36*(9), 1-9.

Simons, L. E., Claar, R. L., & Logan, D. L. (2008). Chronic pain in adolescence: Parental responses, adolescent coping, and their impact on Adolescent's pain behaviors. *Journal of Pediatric Psychology, 33*(8), 894-904.

Simons, L. E., Pielech, M., Erpelding, N., Linnman, C., Moulton, E., Sava, S., et al. (2014). The responsive amygdala: Treatment-induced alterations in functional connectivity in pediatric complex regional pain syndrome. *Pain, 155*(9), 1727-1742.

Simons, L. E., Sieberg, C. B., Carpino, E., Logan, D., & Berde, C. (2011). The fear of pain questionnaire (FOPQ): Assessment of pain-related fear among children and adolescents with chronic pain. *Journal of Pain, 12*, 677-686.

Simons, L. E., Sieberg, C. B., Pielech, M., Conroy, C., & Logan, D. E. (2013). What does it take? comparing intensive rehabilitation to outpatient treatment for children with significant pain-related disability. *Journal of Pediatric Psychology, 38*(2), 213-223.

Stanford, E. A., Chambers, C. T., Biesanz, J. C., & Chen, E. (2008). The frequency, trajectories, and predictors of adolescent recurrent pain: A population-based approach. *Pain, 138*(1), 11-21.

Starkweather, A. R., Heineman, A., Storey, S., Rubia, G., Lyon, D. E., Greenspan, J., et al. (2016). Methods to measure peripheral and central sensitization using quantitative sensory testing: A focus on individuals with low back pain. *Applied Nursing Research, 29*, 237-241.

Subhadra, E., & Kennan, T. R. (2007). Parents with chronic pain: Are children equally affected by fathers as mothers in pain? A pilot study. *Journal of Child Health Care, 11*(2), 143-157.

Swain, M. S., Henschke, N., Kamper, S. J., Gobina, I., Ottova-Jordan, V., & Maher, C. G. (2014). An international survey of pain in adolescents. *BMC Public Health, 14*, 447.

von Baeyer, C. L., Spagrud, L. J., McCormick, J. C., Choo, E., Neville, K., & Connelly, M. A. (2009). Three new datasets supporting use of the numerical rating scale (NRS-11) for children's self-reports of pain intensity. *Pain, 143*, 223-227.

Vowles, K. E., Cohen, L. L., McCracken, L. M., & Eccleston, C. (2010). Disentangling the complex relations among caregiver and adolescent responses to adolescent chronic pain. *Pain, 151*(3), 680-686.

Walker, L. S., & Greene, J. W. (1991). The functional disability inventory: Measuring a neglected dimension of child health status. *Journal of Pediatric Psychology, 16*, 39-58.

Young, L., & Kemper, K. J. (2013). Integrative care for pediatric patients with pain. *Journal of Alternative and Complementary Medicine, 19*(7), 627-632.

Zernikow, B., Wager, J., Hechler, T., Hasan, C., Rohr, U., Dobe, M., et al. (2012). Characteristics of highly impaired children with severe chronic pain. *BMC Pediatrics, 12*, 54.

CURRICULUM VITAE

Alina Agamov

Address: 267 Hartman Rd, Newton, MA 02459 • Phone: (617) 899-1286

E-mail: alina.agamov@gmail.com • Year of Birth: 1992

EDUCATION

Boston University, Boston, MA

Masters in Medical Sciences Candidate Expected May 2016

Bachelor of Arts in Environmental Science, Minor in Public Health May 2014

Boston University Study Abroad Science Program

Universite Joseph Fourier, Grenoble, FR Aug 2011-Dec 2011

RESEARCH EXPERIENCE

Boston Children's Hospital

Biobehavioral Pediatric Pain Lab

Graduate Student Research Intern Aug 2015-Present

- Lead study focusing on relationship with parent and children pain sensitivity within a chronic pain cohort.
- Perform chart reviews and run Quantitative Sensory Testing.
- Recruit patients for biopsychosocial studies going on in the lab.
- Use SPSS to analyze data.
- Participate in biweekly journal club.

Boston University, Boston, MA

Research Assistant, Child Language Laboratory Jan 2013-May 2014

- Received Student Research Award and Funded Research Opportunity Grant
- Lead study focusing on language acquisition issues with children with ASD including collecting, exporting, formatting, and analyzing data as sole undergraduate under supervision of graduate student.
- Use Tobii studio and R script to perform and analyze data.

Research Assistant, Ona Environmental Health Laboratory Sept 2010-Dec 2012

- Conducted primary and secondary source research and literature review on residual pesticide exposure to Haitian farm workers in the Dominican Republic.
- Results contributed to professor's future grant proposal for ethic review boards.

Institut Jean Roget, Grenoble, FR

Laboratoire Adaptation et Pathogénie des Micro-organismes

Intern Nov 2011-Dec 2011

- Shadowed CNRS scientist in intracellular parasitism lab of parasitology.
- Studied protozoan *Toxoplasma gondii* and how it affects its host cell, specifically looking at biogenesis and the function of the vacuole of this specific parasite.

LEADERSHIP EXPERIENCE

Science Club for Girls

Mentor Sept 2015-Present

- Work directly with twelve students in grades four and five.
- Run weekly afterschool activities in the science curriculum.

Boston University, Boston, MA

Cofounding Member, FaceAIDS Sept 2010 –May 2014

- Collaborate with Partners in Health to raise HIV/AIDS awareness on campus.
- Successfully solicited funding and sponsorship from local businesses for inaugural Condom Couture Fashion Show in Spring 2013.

Learning Assistant, Physics Department Sept 2013-Dec 2013

- Work directly with 81students in introductory to physics classroom to review concepts and explain activities.
- Plan test review sessions before every exam.
- Answer students' questions regarding homework problems, lab exercises, and conceptual understanding.

VOLUNTEER EXPERIENCE

Birthday Wishes

Volunteer Nov 2015-Present

- Perform monthly visits to main office to help wrap presents and prepare birthday gifts for children in shelters around the Greater Boston Area.

Chestnut Park At Cleveland Circle, Brookline, MA

Volunteer March 2012-Present

- Perform weekly visits to elderly home to spend time and help run activities with the residents.

Partners in Health Engage, Boston, MA
Volunteer Dec 2014-June 2015

- Participate in activities such as letter writing campaigns and phone-a-thons that help Partners in Health in advocacy, fundraising, and education for the human right to health campaign

Medical Career Exploration Program, Boston, MA
Brigham and Women's Hospital, Endoscopy Department March 2012-Dec 2012

- Interact with both patients and medical staff and assist front desk with customer service.

SKILLS

Language: Bilingual: English/Russian (Native); Basic knowledge: French
Computer: Microsoft Office including Excel and PowerPoint, Tobii Studio, R Script

AWARDS

College of Arts and Sciences Dean's List 2013-2014
Undergraduate Research Opportunity Program Grant 2013-2014